Madroño, Vol. 62, No. 1, pp. 68–72, 2015

IMBRIBRYUM TORENII (BRYACEAE), A NEW SPECIES FROM WESTERN NORTH AMERICA

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Abstract

Imbribryum torenii J.R. Spence & Shevock is described and illustrated. This species appears related to *I. alpinum* (Hudson *ex* Withering) N. Pedersen and *I. muehlenbeckii* (Bruch & Schimper) N. Pedersen. *Imbribryum torenii* is readily distinguished from these two species by a combination of characters including broadly ovate leaves, short excurrent costa, hexagonal distal laminal cells, cylindric capsule, and large spores.

Key Words: *Bryum*, *Imbribryum*, mosses, California, Oregon, Washington, British Columbia.

The largest concentration of Bryaceae in North America resides in California (Spence 2014; Norris and Shevock 2004). The combination of its complex geology, Mediterranean climate of wet winters and dry summers, as well as its elevational range from coastal scrub to alpine fell-fields, all contribute to the high diversity of this family in the state. The genus *Bryum* s.l. with nearly 500 recognized species (Crosby et al. 2000) is extremely diverse in growth form, leaf morphology, and with various types of gemmae and tubers. For some time it was suspected that *Bryum* Hedwig, as traditionally circumscribed, was polyphyletic (Cox and Hedderson 2003). Several genera have been proposed to address this issue. Molecular data is providing additional insight in conjunction with morphological characteristics generally used in the circumscription of taxa. Within *Bryum* s.l. is a group of mosses with rather rigid equally foliate stems generally occurring in seasonally wet habitats over rock. The genus *Imbribryum* N. Pedersen was proposed by Pedersen (2005) to accommodate this suite of taxa. Western North America currently has six described species of *Imbribryum*, all of which occur in California. Here we describe a new species of *Imbribryum* from the region.

Taxonomic Treatment

Imbribryum torenii J.R. Spence & Shevock, sp. nov. (Fig. 1).—TYPE: USA, California, Monterey Co., Fort Hunter Liggett Military Reservation, along Gabilan Road at bridge crossing Nacimiento River, southern end of the Palisades, T24S, R7E, section 15, 35°51′05″N, 121°11′51″W, 1100 ft, 10 Apr 2004, *Shevock, Kellman, Robertson & Eliassen 24830* (holotype: CAS; isotypes MO, NY).

Related to *I. alpinum* and *I. muehlenbeckii*. Plants medium-sized; stems 0.5–3 cm, evenly foliate, not julaceous; leaves red or with red tints, imbricate, broadly ovate, somewhat concave, not decurrent; costa strong, percurrent to mostly short excurrent in short stout awn; laminal cells thin to firm walled, distal cells hexagonal, 3–5:1, proximal cells short rectangular to quadrate, 1–2:1, limbidium absent; capsule elongate cylindric; peristome perfect; operculum strongly convex, short rostrate; spores yellow-brown, mostly 16–20 μm.

Plants medium-sized, in open to dense turfs, dark red to red-green, rarely entirely green, sometimes becoming black-red with age. **Stems** 0.5–2(–3) cm, evenly foliate, not julaceous, lacking metallic sheen, older portions of stem sometimes densely radiculose. **Leaves** 1.5–3 mm, red to red green or sometimes green, strongly imbricate when dry, erect when wet, rigid, broadly ovate, concave, not or weakly decurrent; apex broadly acute; margins strongly revolute, often to near apex, margins smooth to finely serrulate distally, limbidium absent; costa strong, reddish, percurrent to mostly short-excurrent as a stout awn; distal and mid-laminal cells hexagonal (40–) 50–65 × (10–) 12–20 μm, mostly 3–4:1, thin to firm-walled but not incrassate, parallel to costa, proximal laminal cells abruptly quadrate to short-rectangular, 1–2 (–3):1, occasionally a single row of colored cells present across leaf base. **Specialized asexual reproduction** of red to red-brown spherical rhizoidal tubers on rhizoids arising from leaf axils, 100–300 μm, scarce. **Dioicous. Gametangial leaves** similar to vegetative leaves but smaller. **Seta** 1–3 cm, stout, more or

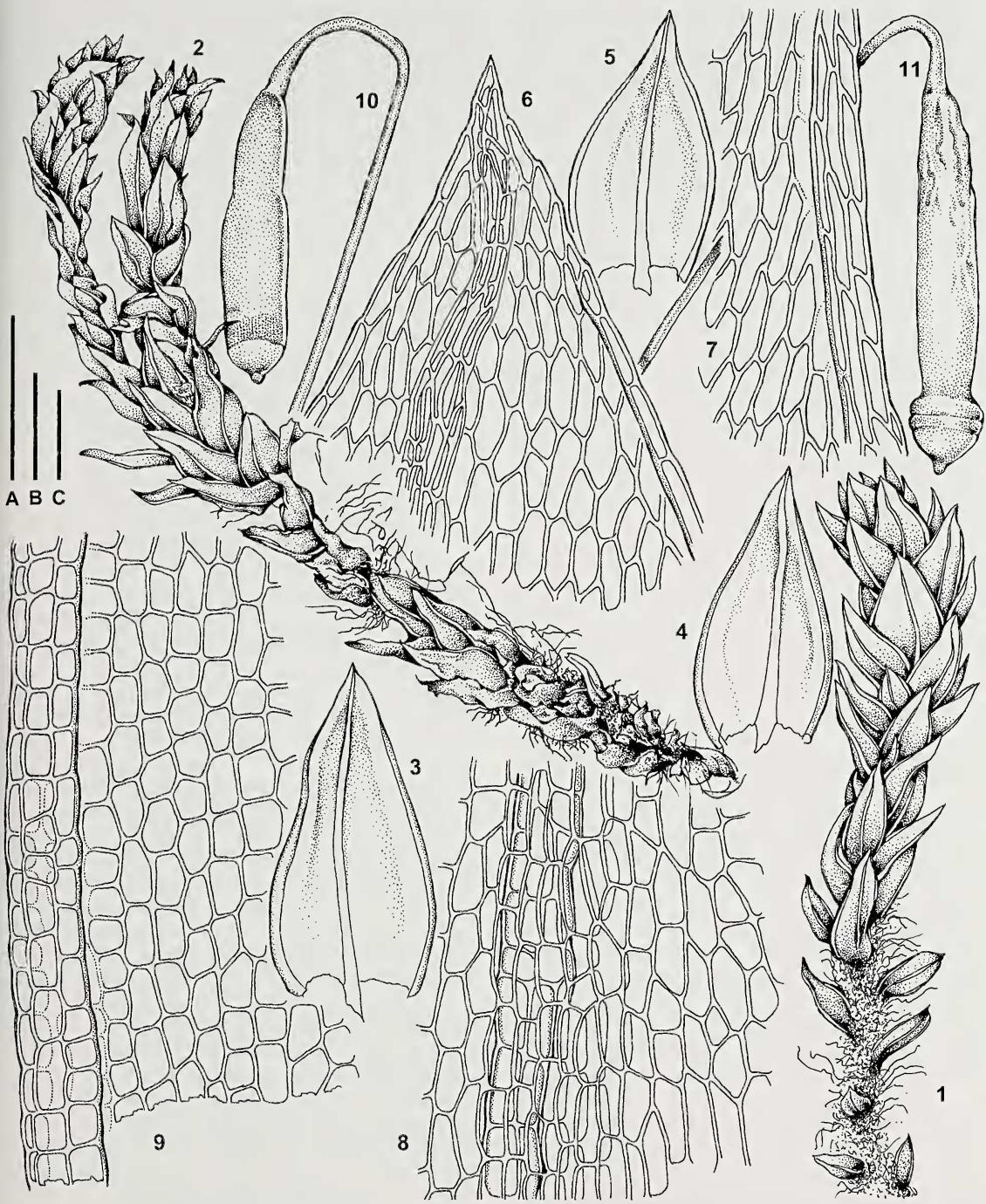

FIG. 1. *Imbribryum torenii*. 1. Habit, moist. 2. Habit, dry. 3–5. Leaves. 6. Apical leaf cells. 7. Median marginal leaf cells. 8. Median laminal cells. 9. Basal leaf cells. 10. Capsule, moist. 11. Capsule, dry. Scale bars: A: 2 mm, figs. 1, 2, 10, 11; B: 0.5 mm, figs. 3–5; C: 50 μm, figs. 6–9.

less straight, red or red-brown. **Capsule** 3–4 mm, cylindric, short-necked, inclined to nutant, red-brown; exothecial cells irregularly rectangular, 40–70 × 20–30 um, walls red, incrassate, 2–3 rows of shorter strongly reddish cells below mouth; exostome teeth yellow-brown, endostome membrane pale, free, ½ or more height of exostome, processes well developed, slender, perforations ovate, cilia well developed, 2–3, appendiculate; operculum strongly convex, short-rostrate. **Spores** yellow-brown, distinctly papillose, variable in size, (14) 16–20 (22) μm.

Paratypes: CANADA, BRITISH COLUMBIA. Vancouver, Queen Elizabeth Park near Quay Gardens, 19 Apr 2007, *Joya s.n.* (CAS, UBC) and University of British Columbia campus, 28 Mar 2011, *Joya 1263* (CAS, UBC), Reginald Hill, Salt Spring Island, 16 Apr 2001, *Sadler 768* (UBC). USA, CALIFORNIA. **Butte Co.**: south side of Thermalito Diversion Pool, base of Oroville Dam, 82 m, 4 Mar 2014, *Janeway 11212* (CAS, CHSC). **Contra Costa Co.**: west of Vasco Road, about 4.5 miles west of Bryon and 1 mile north of Alameda county line, Vasco Caves Preserve, East Bay Regional Parks, 750–1000 ft, 19 Mar 1997, *Shevock, O'Brien & Jessup 14998* (CAS); *15014a* (CAS, NY). **Fresno Co.**: Glen Meadow Creek toward Dinkey Lakes, Sierra National Forest, 6300 ft, 27 Jul 1996, *Bourell & Shevock 6448* (CAS); Ross Landing, Sierra National Forest, 4350 ft, 7 Jun 1996, *Shevock, Ertter & York 13470* (CAS); Cedarbrook Picnic Area near Pinehurst, Sequoia National Forest, 4250 ft, 24 May 1998, *Shevock 17132* (CAS). **Lake Co.**: High Valley north of Clear Lake, 1750 ft, 11 Feb 2002, *Toren & Dearing 8958* (CAS); Manning Creek, 1450 ft, 12 Apr 2007, *Toren & Dearing 9579* (CAS); Jerusalem Grade Road, 1200 ft, 11 Feb 2013, *Toren & Dearing 9987* (CAS); east tributary to South Fork of Scotts Creek, 0.5 mi south of confluence of main stem of Scotts Creek, 1500 ft, 12 May 2014, *Toren & Dearing 10176* (CAS). **Madera Co.**: San Joaquin River near Rainbow Falls, Devils Postpile National Monument, 7400 ft, 25 Sep 2001, *Shevock & Dulen 21283* (CAS, MO); Beasore Road just east of Portuguese Creek, southwestern slope of the Balls, Sierra National Forest, 7300 ft, 8 Jul 2000, *Shevock & Kellman 19860* (CAS). **Mariposa Co.**: El Portal-Foresta Road near the Stanislaus National Forest and Yosemite National Park boundary, 735 m, 1 May 2009, *Hutten 14490* (CAS). **Monterey Co.**: above the South Fork of Devils Canyon, Ventura Wilderness, Los Padres National Forest, 540 m, 25 Feb 2006, *Kellman & Shevock 5028* (CAS), Wagon Caves, Los Padres National Forest, 1490 ft, 22 Mar 2004, *Shevock et al. 24714* (CAS, MO), Horse Pasture Trail, Ventana Wilderness, Los Padres National Forest, 1140 ft, 4 Mar 2012, *Shevock & Kellman 39627* (CAS, MO). **Napa Co.**: Mayacmas Mountains, Kimball Canyon near Red Hill, Robert Louis Stevenson State Park, 1940 ft, 14 Mar 2014, *Shevock, Burge & Penneys 44643* (CAS, NY). **San Benito Co.**: Balconies Trail near Ranger Station, Pinnacles National Monument, 1350 ft, 12 Feb 2005, *Shevock & Hurley 26281* (CAS). **Sonoma Co.**: road above Devils Kitchen, Pepperwood Ranch 6 mi east of Santa Rosa, 25 Jun 1982, *Bourell 1786* (CAS). **Tulare Co.**: Cherry Hill Road at Brush Creek, Kern Plateau, Sequoia National Forest, 5700 ft, 24 May 1997, *Shevock 15558* (CAS, NY). USA, OREGON. **Wheeler Co.**: highway 26 north of Butte Creek Pass above Service Creek, 2215 ft, 23 Mar 2008, *Shevock & Kellman 31610* (CAS). USA, WASHINGTON. **Klickitat Co.**: north side of hwy 142 just east of town of Klickitat along the Columbia River, 1 Aug 2012, 469 ft, 2012, *Toren & Harpel 9941a*, *Harpel & Toren 50846* (CAS, UBC).

Taxonomic Relationships

All the other species of North American *Imbribryum* occur within the range of *I. torenii*. Three species typically lack any reddish tints to the leaves, *I. gemmiparum* (De Notaris) J.R. Spence, *I. microchaeton* (Hampe) J.R. Spence, and *I. mildeanum* (Juratzka) J.R. Spence. However, the four red-colored species can also produce green leaves. These leaves tend to be new growth of the current year, and generally they turn reddish as the habitat dries out.

Two species, *I. alpinum* (Hudson ex Withering) N. Pedersen and *I. microchaeton*, have narrowly ovate more or less flat leaves, excurrent costa, acute to acuminate leaf apices, and extremely long distal laminal cells that are thick-walled and somewhat vermicular, distinguishing them from all other species.

Among the remaining five species. *I. torenii* appears to be closest to *I. muehlenbeckii* (Bruch & Schimper) N. Pedersen. The two differ in several features, and with rare exceptions can readily be distinguished. The leaves of *I. muehlenbeckii* are strongly concave, with mostly obtuse apices and a percurrent costa, giving the stems a distinctly julaceous look. When placed on a slide and covered with a cover slip, most leaves split apart due to their concavity. *Imbribryum torenii* leaves are less concave, acute, with most leaves having a strong short-excurrent costa into a stout short awn, and the stems are not julaceous. On a slide, the leaves typically do not split apart. The leaf base of *I. torenii* has a relatively broad insertion on the stem, while that of *I. muehlenbeckii* is relatively much more narrow. In size, *I. torenii* is typically a more robust species with much broader leaves. In addition, the margins are very strongly revolute to mostly $>½$ the leaf length, while in *I. muehlenbeckii* they are only weakly revolute proximally. The capsule of *I. torenii* is slender and cylindric, while that of *I. muehlenbeckii* is short pyriform. The spores are different in size, with those of *I. torenii* generally from 16 up to 20–22 μm, while those of *I. muehlenbeckii* are typically 10–14 μm.

Of the other species, *Imbribryum miniatum* (Lesquereux) J.R. Spence is highly distinctive with its strongly concave leaves with cucullate apices, julaceous stems, elongate incrassate distal laminal cells that are often oblique (20–30° away) to the costa, and presence of one or more rows of

distinctly colored and somewhat enlarged cells across the leaf base. *Imbribryum gemmiparum* is a bright green to yellow-green species lacking any red tints, has obtuse leaf apices with thin walled laminal cells, and is generally found in more or less permanently wet calcareous sites such as springs. *Imbribryum mildeanum* is a fairly robust species that generally has a distinctive yellow-gold color, although rarely some collections have a faint metallic reddish tint to older leaves. The leaves are more or less flat, elongate and narrowly ovate to ovate-lanceolate.

In addition, *I. torenii* may possibly be confused with forms of *Ptychostomum pseudotriquetrum* (Hedwig) J.R. Spence & H.P. Ramsay because of a superficial resemblance and the two can occur sympatrically. However, the latter species has a stronger leaf border, longer basal leaf cells, decurrent leaf bases and lacks rhizoidal tubers.

Key to Pacific Slope *Imbribryum*

1. Leaves rigid and strongly imbricate when dry; distal laminal cells long, incrassate and vermicular, >6:1 length/width
   2. Plants dark green to red, often shiny, costa percurrent to short-excurrent; limbidium absent; proximal laminal cells gradually wider proximally, short-rectangular to quadrate; capsule pyriform with short neck . . . . . 1. *Imbribryum alpinum*
   2. Plants pale green, somewhat dull, costa short to moderately long-excurrent into a slender awn; weak to moderately strong limbidium present; proximal laminal cells abruptly enlarged, somewhat bulging, rectangular; capsule cylindric to narrowly pyriform, with distinct, long neck . . . . . 3. *Imbribryum microchaeton*
1. Leaves rigid to somewhat loosely imbricate; distal lamina cells shorter, not vermicular, mostly 3–5:1, thin walled to incrassate
   3. Stems strongly julaceous; leaves red or purple, rarely green, strongly concave, apices rounded-obtuse to broadly acute, cucullate; costa percurrent; distal lamina cells incrassate, oblique to costa, proximal laminal cells enlarged in 1–2 rows across leaf base . . . . . 5. *Imbribryum miniatum*
   3. Stems not or weakly julaceous; leaves red to green or yellow, concave to flat, apices obtuse, acute, or acuminate, not cucullate; costa not reaching apex to excurrent; distal lamina cells thin to somewhat firm-walled, parallel to costa, cells at leaf base not inflated or enlarged 4
      4. Plants yellow, golden, or green, generally lacking reddish tints, older leaves becoming stramineus with age; leaves flat or weakly concave, slender ovate to ovate-lanceolate, apices acute to acuminate; costa short-excurrent in slender, sometimes denticulate awn . . . . . 4. *Imbribryum mildeanum*
      4. Plants green, yellow-green or red, older leaves not becoming stramineus, although sometimes becoming dark brown with age, leaves distinctly concave, ovate, apices broadly acute or obtuse; costa not reaching apex, percurrent, or short-excurrent in stout point 5
         5. Leaves green to yellow-green, lacking red tints, loosely set, somewhat distant proximally along stem, leaf apex rounded-acute to obtuse, costa not reaching apex or percurrent, small apiculus sometimes present, found in wet calcareous habitats. . . . . 2. *Imbribryum gemmiparum*
         5. Leaves red or red-green, red tints usually present, rigid and imbricate, crowded; leaf apex rounded-acute, obtuse to acute, costa not reaching apex, percurrent or short-excurrent in stout point, apiculus absent; found in seasonally wet habitats, often acidic . . 6
            6. Plants somewhat julaceous; costa not reaching apex, rarely percurrent, leaf apex rounded-acute to obtuse, leaves strongly concave, narrowly ovate, leaf base at insertion narrow, margins revolute proximally; capsule pyriform; acidophile or on highly mineralized igneous or metamorphic rock. . . . . 6. *Imbribryum muehlenbeckii*
            6. Plants not julaceous; costa percurrent to mostly short-excurrent in stout point, leaf apex acute, leaves somewhat concave, broadly ovate, leaf base at insertion broad, margins strongly revolute more than ½ distance to leaf apex; capsules cylindric; found in a variety of substrates, not restricted to acidic rock . . . . 7. *Imbribryum torenii*

Habitat and Ecology

Most species of *Imbribryum* including *I. torenii* are found on seasonally wet rocks, seepage areas on slopes, stream banks, rivulets, and intermittent drainages. Although *I. alpinum* and *I. muehlenbeckii* have strong preferences for moderately to strongly acidic rock especially influenced from snowmelt, *I. torenii* is more of a generalist, and is found on a wide variety of rocks varying from calcareous to moderately acidic. The species is found predominantly at low to middle elevations (sea level to ca. 7000 ft), in open sites. *Imbribryum alpinum* has a similar distribution, but is much rarer, while *I. muehlenbeckii* is a rare species mostly found at higher elevations in the Sierra Nevada and Cascade Ranges.

Distribution

Among the predominantly red-colored species of *Imbribryum* west of the Sierra Nevada-Cascade

crests, *I. miniatum* and *I. torenii* are the two most common species, which can occur sympatrically. Like other primarily Californian endemics, the species does not appear to extend inland into the drier Intermountain Region or deserts. Based on known occurrences *I. torenii* appears most common in California, and as disjunct populations northward through Oregon, Washington, and coastal British Columbia. *Imbribryum torenii* is fairly common in the Gulf islands of the British Columbia Puget Sound region and is likely to also occur in the San Juan Islands of Washington State, in areas of disjunct Mediterranean climate that harbors other bryophyte species from California.

Conservation Implications

The species is fairly common within its range, especially in California, and occurs in a wide variety of habitats. Thus the species appears to be currently secure. However, future climate change that includes increasing temperatures and drier conditions may impact the species as seasonally wet habitats are diminished.

Acknowledgments

We thank Patricia Eckel for developing the illustrative plate. It is a pleasure to name this new species after David Toren who originally sent specimens of this plant to the first author. His keen eye, great attention to detail, and knowledge of mosses in the field has aided us in many ways in learning more about the diversity and complexity of bryaceous taxa in California, especially from Lake County.

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